IN THE SPECIFICATION

Detailed Description

*In **Figures 1 and 2**, described in greater detail below, a layered stack 100 includes a substrate 110, a first layer 120, a second nanoporous layer 130, and an additional layer 140. In preferred embodiments, the first layer 120 in layered stack 100 includes either a continuous layer of non-volatile component 128 (**Figure 1**) or voids 125 and a non-volatile component 128 (**Figure 2**). The second layer 130 in layered stack 100 includes voids 135 and non-volatile component 138. The additional layer 140 in layered stack 100 may include voids 145 and non-volatile component 148.* Volatile components 126 and 146 are not shown in the Figures.

DRAWINGS

The drawings are objected to as failing to comply with 37 CFR 1.84 (p)(5) because they do not include the following reference sign(s) mentioned in the description: Reference numbers 126 and 146.

The Applicant understands the Examiner's objection and respectfully requests that the Detailed Description be amended instead to reflect that "volatile components 126 and 146 are not shown in the Figures." This proposed specification amendment is shown above in the "In the Specification" section of this Response. Given that Reference numbers 126 and 146 refer to volatile components, both will be difficult to represent in the Figures. However, if the Examiner insists that they be shown in the Figures, the Applicant proposes that both Reference Numbers 126 and 146 be shown as they are in attached "Proposed Figure 1". Please contact the undersigned Attorney-of-Record as soon as possible to discuss which method of revision is acceptable at this time, so that the Figures can be redrafted immediately.

35 USC §112

Claims 4, 5, 8, 15, 17 and 34 are rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Applicant respectfully disagrees, especially in view of amendments made herein.

Claim 8 is herein amended to recite: "The material of claim 3, wherein the first layer nanoporous material comprises a polymer.". This amendment provides the clarification sought by the Examiner on page 3 of Paper No. 9.

Claim 1 is herein amended to recite that the first layer is on the surface of the substrate, the second layer is on the surface of the first layer, and the additional layer is at least partially on the surface of the second layer. This amendment is fully supported by the Detailed Description in combination with the Figures showing a layered material such that the layers (bottom side of the layer) are deposited on the surface (top side) of the underlying layer and not laid "side by side", as the Examiner appears to be suggesting. The Applicant further notes that although the Dictionary definition of the term "juxtapose" means to place "side by side", it should be clear that the use of the term in the Detailed Description coupled with the Figures shows that "side by side" means top side and bottom side ("side on side") given that it's a layered material and/or component.

Claim 34 is amended herein to recite " The material of claim 3, wherein the nanoporous material of at least one of the first layer or the second layer comprises an adamantane-based compound." This amendment should provide the required clarification that the Examiner is requesting on page 4 of Paper No. 9.

<u>35 USC §103</u>

Claims 1-5, 8, 10-15 and 17 are rejected under 35 USC §103(a) as being unpatentable over Chen et al. (US Patent No. 5,858,869) in view of O'Neill (US Patent No. 6,187,248). The Applicant respectfully disagrees.

Claim 1 recites: " A layered low dielectric constant nanoporous material comprising: a first layer on the surface of a substrate; a second layer that comprises a nanoporous material and on the surface of the first layer; and a first additional layer at least partially on the surface of the second layer, wherein the structural strength of the layered material increases by at least 100%." The provision in claim 1 reciting that the structural strength of the layered material increases by at least 100% is discussed in the Detailed Description and specifically referenced in the Examples section, whereby a layered material's structural strength from a Stud Pull Test goes from 2 Kpsi to at least 4 Kpsi once the second layer is infiltrated by an additional layer.

Chen et al. (Chen) teaches a method for making multilevel electricl interconnections having a planar intermetal dielectric (IMD) with low dielectric constant k and good thermal conductivity. As the Examiner states, there is no teaching or suggestion in Chen that the dielectric material comprise pores or nanopores.

O'Neill et al. (O'Neill) teaches a process for producing a nanoporous polymer film of no greater than 10 micron thickness having a low dielectric constant value. As the Examiner points out, O'Neill does discuss in the Background Section the state of the art in porous dielectric materials, how they had been utilized in microelectronics up to that point, and how certain embodiments had failed. For example, O'Neill states in Columns 1 and 2 that porous dielectric materials with high porosity content have consistently failed in the microelectronics industries because they were too brittle and were not easily processed or incorporated into other components. O'Neill suggests that the way to get over this hurdle is to use phase inversion with polymeric materials and solvents to produce porous dielectric materials, and then to crosslink the polymer materials to better withstand temperature variations and handling. (See Column 2, lines 53-67). Despite all of the methods and processes that O'Neill uses to increase the strength of the porous dielectrics, the one thing that is not

taught, suggested or considered is to add an infiltrating layer or an additional layer at least in part to the nanoporous layer (whether it's the first layer, the second layer or both) to increase the structural strength of the layered material by at least 100%, as is the case in the present application. There is also no motivation to one of ordinary skill in the art of dielectric materials and semiconductor processing and production to add an additional layer to the porous or nanoporous dielectric material in order to increase the structural strength of the layered material as a whole.

Furthermore, there is no combination of Chen and O'Neill that would give the claims of the present application, since there is no motivation, suggestion or teaching to produce a layered material having at least one nanoporous layer, whereby the nanoporous layer is strengthened by at least 100% through the addition of an additional layer. The background of the present application teaches this concept in this manner:

> "Regardless of the approach used to introduce the voids, structural problems are frequently encountered in fabricating and processing nanoporous materials. Among other things, increasing the porosity beyond a critical extent (generally about 30% in the known nanoporous materials) tends to cause the porous materials to be weak and in some cases to collapse in single-layer dielectric applications. Collapse can be prevented to some degree by adding crosslinking additives to the starting material that couple thermostable portions with other thermostable portions, thereby producing a more rigid single-layer dielectric network. **However, the porous material, even after cross-linking, can lose mechanical strength as the porosity increases, and the material will be unable to survive during integration of the dielectric film to a circuit. Also, the porous material, even after cross-linking, can lose mechanical strength by not having external support by additional coupled nanoporous layers**." (Emphasis added)

This section in the background of the present application points out that no matter how one forms the pores in the dielectric material that incorporation and utilization of that porous material in a layered stack without additional structural strength support can cause failure in the layered material or component. Chen does not teach providing additional layers on the underlying dielectric

layers in order to provide or increase the structural strength of the layered material and of the porous dielectric material. Chen only teaches providing additional hardmask or other processing layers that contribute to the production of the component or the component itself in some way other than to provide or increase structural strength. Therefore, it would not be obvious to combing the teachings of O'Neill with the teachings of Chen to produce the layered material of the present application, since it is clear that a key component of the present application is missing from both references – alone or in combination.

Based on these arguments, claim 1 of the present application is not obvious in view of Chen in combination with O'Neill. Furthermore, claims 2-5, 8, 10-15 and 17 are also not obvious in view of Chen in combination with O'Neill given their dependence on independent claim 1.

Claim 34 is rejected under 35 USC §103(a) as being unpatentable over Chen et al. (US Patent No. 5,858,869) in view of O'Neill (US Patent No. 6,187,248) as applied to claims 1 and 3 above, and further in view of Lau et al. (US Patent No. 6,509,415). The Applicant respectfully disagrees.

As a procedural matter, the Applicant herein attaches a Declaration Under 37 USC § 1.132 that removes Lau et al. as a prior art reference. As mentioned in the Declaration:

1. Both the above-referenced application and US 6,509,415 were **originally commonly owned** by Honeywell International Inc. at the time the later invention was made.

2. US 6,509,415 is a US Utility Patent based on US Serial Number 09/545,058 filed on April 7, 2000 and issued on January 21, 2003.

3. The above-referenced application was filed on December 19, 2000 as US Serial No. 09/741,634.

4. Both the above-referenced application and US Issued Patent No. 6,509,415 **were co- pending applications** from December, 2000 until January, 2003.

Therefore, Lau et al. cannot properly be considered a prior art reference by the Examiner, and thus, the substantive rejections relating to Lau will not be addressed herein. Further, independent claim 1 and dependent claims 3 and 34 are allowable as being patentable over Lau et al. The Applicant respectfully invites the Examiner to contact the undersigned Attorney-of-Record, if this issue remains unresolved by this Response.

To address the remaining substantive matters, claim 1 recites: " A layered low dielectric constant nanoporous material comprising: a first layer on the surface of a substrate; a second layer that comprises a nanoporous material and on the surface of the first layer; and a first additional layer at least partially on the surface of the second layer, wherein the structural strength of the layered material increases by at least 100%." The provision in claim 1 reciting that the structural strength of the layered material increases by at least 100% is discussed in the Detailed Description and specifically referenced in the Examples section, whereby a layered material's structural strength from a Stud Pull Test goes from 2 Kpsi to at least 4 Kpsi once the second layer is infiltrated by an additional layer.

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temperature variations and handling. (See Column 2, lines 53-67). Despite all of the methods and processes that O'Neill uses to increase the strength of the porous dielectrics, the one thing that is not taught, suggested or considered is to add an infiltrating layer or an additional layer at least in part to the nanoporous layer (whether it's the first layer, the second layer or both) to increase the structural strength of the layered material by at least 100%, as is the case in the present application. There is also no motivation to one of ordinary skill in the art of dielectric materials and semiconductor processing and production to add an additional layer to the porous or nanoporous dielectric material in order to increase the structural strength of the layered material as a whole.

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CHANGE OF CORRESPONDENCE ADDRESS & POWER OF ATTORNEY

Please find enclosed a copy of the Change of Correspondence Address for this matter. The Change of Correspondence Address documents were filed with the USPTO on April 16, 2003. Please note that although the firm representing the Applicant has changed, the Attorney-of-Record has not changed. Sandra Poteat Thompson (USPTO Reg. No. 46,264 and formerly Sandra Poteat) is listed on the current Power of Attorney documents for this application.

<u>REQUEST FOR ALLOWANCE</u>

Claims 1-5, 8, 10-15, 17, 34-43 are pending in this application. The applicants request allowance of all pending claims.

Respectfully submitted,

Dated: April 29, 2003

By: Sandra Thompson

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<u>CLEAN COPY OF THE SPECIFICATION</u>

Detailed Description

In **Figures 1 and 2,** described in greater detail below, a layered stack 100 includes a substrate 110, a first layer 120, a second nanoporous layer 130, and an additional layer 140. In preferred embodiments, the first layer 120 in layered stack 100 includes either a continuous layer of non-volatile component 128 (**Figure 1**) or voids 125 and a non-volatile component 128 (**Figure 2**). The second layer 130 in layered stack 100 includes voids 135 and non-volatile component 138. The additional layer 140 in layered stack 100 may include voids 145 and non-volatile component 148. Volatile components 126 and 146 are not shown in the Figures.